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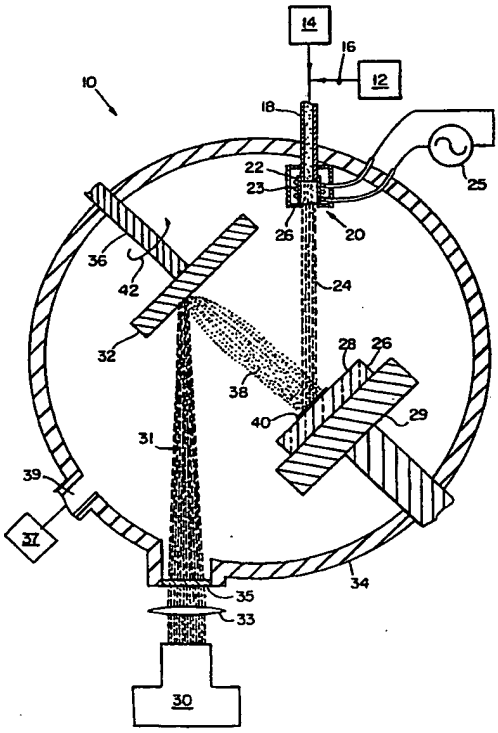
(54) Title: EXTENDED NITRIDE MATERIAL COMPRISING β-C_3N_4

(57) Abstract

An extended nitride material comprises β-C_3N_4. A method of forming an extended nitride material includes forming an atomic nitrogen source, forming an elemental reagent source and combining the atomic nitrogen and elemental reagent to form the extended nitride material. The elemental reagent is reactive with the atomic nitrogen of the atomic nitrogen source to form the extended nitride material. The apparatus of the invention can include, for example, a radio-frequency (rf) discharge nozzle (26) for forming the atomic nitrogen source, such as an atomic nitrogen beam (24). The elemental reagent source can be formed by employing a pulsed laser to ablate a suitable target (32), such as a graphite target, to thereby form an ablation plume (38) of elemental carbon. The ablation plume (38) and the atomic nitrogen beam (24) combine and cause the elemental carbon reagent and the atomic nitrogen to react and form the extended nitride material. The extended nitride material can accumulate as a film on a suitable substrate (40), such as Si(100) or polycrystalline nickel.



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INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/US 94/07964

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,91 16196 (UNIV OF CALIFORNIA) 31 October 1991	1-3, 10-12, 19,20,45
A	see table 2	4-9, 13-18, 21-44, 46-50

X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 469 (E-1271) 29 September 1992 & JP,A,04 167 405 (ANELVA CORP) 15 June 1992	20-22, 46,47
Y	see abstract	23,24, 48-50

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Authorized officer Ekhult, H

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INTERNATIONAL SEARCH REPORT

Intern. al Application No
PCT/US 94/07964

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	APPLIED PHYSICS LETTERS, vol.62, no.17, 26 April 1993, U.S pages 2116 - 2118, XP364792 I. SUGIMOTO 'HELIUM-EXCITED REACTIVE MAGNETRON SPUTTERING FOR STRESS-FREE SILICON NITRIDE FILMS' see page 2117, left column, line 41 - right column, line 20	23
Y	EP,A,0 439 135 (SUMITOMO ELEC IND KK) 31 July 1991	24
Y	EXTENDED ABSTRACTS, SPRING MEETING, vol.89/1, May 1989, U.S page 118, XP133687 J. KRISHNASWAMY ET AL 'A NEW LASER PLASMA ABLATION TECHNIQUE FOR THE DEPOSITION HARD DIAMOND LIKE CARBON FILMS' *EXPERIMENTAL PROCEDURE*	48-50
A	EP,A,0 484 809 (BATTELLE-INST EV) 13 May 1992 see claims 1-8	20-50

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte .onal Application No
PCT/US 94/07964

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9116196	31-10-91	US-A-	5110679	05-05-92
EP-A-0439135	31-07-91	JP-A-	3219066	26-09-91
		JP-A-	4099261	31-03-92
		JP-A-	4107258	08-04-92
		JP-A-	4119982	21-04-92
		JP-A-	4191358	09-07-92
		US-A-	5096740	17-03-92
EP-A-0484809	13-05-92	DE-C-	4035073	05-03-92